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ABSTRACT

The reward structure of a classroom refers to the means by which a teacher motivates students to perform school tasks. This document reports on a study in which academic achievement in competitive and reward-structured environments was examined in two high school sophomore level biology classes of equal academic ability. Each class was pretested and taught an identical unit of study, one in a competitive structure and one using a cooperative structure called the Group-Investigations Model. In this model groups of 5 or 6 students are formed for the study of a particular topic, and each student works on a subtopic for the group. At the end of 7 weeks both classes were post-tested. The results indicated that although both cooperative and competitive techniques obtained significantly higher post-test scores than their pre-test scores, neither strategy was superior to the other in producing academic achievement. Results are discussed and compared to previous studies which have examined differences between cooperatively, competitively, and individually structured classroom environments. (Author/TW)

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ACHIEVEMENT IN COOPERATIVE VERSUS COMPETITIVE REWARD-STRUCTURED SECONDARY SCIENCE CLASSROOMS

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ACHIEVEMENT IN COOPERATIVE VERSUS COMPETITIVE REWARD-STRUCTURED SECONDARY SCIENCE CLASSROOMS.[1]

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ABSTRACT. Academic achievement in competitively and cooperatively reward-structured environments was examined in two high school sophomore level biology classes of equal academic ability. Each was pre-tested and taught an identical unit of study, one in a competitive structure and one using a cooperative structure called the Group-Investigation model. At the end of 7-weeks both classes were post-tested. A two-way within subjects ANOVA was used to determine significant differences in pre- and post-test scores within each class and between treatment groups. The results indicated that although both cooperative and competitive techniques obtained significantly ($p<.05$) higher post-test scores than their pre-test scores, neither strategy was superior over the other in producing academic achievement. Results are discussed and compared to previous studies which have examined differences between cooperatively, competitively and individually structured classroom environments.

INTRODUCTION. The reward structure of a classroom refers to the means by which a teacher motivates students to perform school tasks. Johnson (1979) described three such pedagogical structures as individualistic, competitive, and cooperative. Traditionally, classroom structure has been either individualistic or competitive. In an individualistic structure, students are given individual goals, and a criterion-referenced evaluation system is used to assign rewards. In a competitive system, students are also given individual goals, but are rewarded by means of a norm-referenced evaluation system. Theoretically in a competitive system students discourage the performance of their peers, since one student must fail if another is to succeed (Slavin, 1978b). Success is available to only a few, and many students who could potentially achieve at a high level turn their attention away from academics to peer-supported activities such as sports and social functions (Coleman, 1961). Several studies have discussed the potentially negative effects of a competitive reward system on learning (Holt, 1967; Johnson & Johnson, 1975) and self-concept (Kirschenbaum et al, 1971). In addition, traditionally competitive instruction has been observed to stress the acquisition of

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low level information rather than high level ideas (Sullivan, 1980), stimulate competition and social comparison rather than cooperation (Johnson & Johnson, 1975; Pepitone, 1980), and produce negative intergroup perceptions and attitudes (Cohen, 1980).

In an alternative approach described by Johnson (1979) and called the cooperative or team structure students' rewards depend on the performance of a group. Group members, therefore, encourage each other to do well and to help each other meet their goals. Studies have shown that the use of a cooperative reward structure has had positive effects as compared to a competitive structure on academic achievement (Lucker et al, 1976; Slavin, 1978a; DeVries & Slavin, 1978), mutual concern (Aronson et al, 1975; DeVries & Slavin, 1978), self-esteem (Aronson et al, 1975; Blaney et al, 1977; Slavin, 1978a), and increased interpersonal relationships (DeVries et al, 1978; Slavin, 1978). Theoretically, this occurs because "...groups improve performance due to an increase in peer norms favoring performance and because they provide opportunities and motivation for students to help one another. They increase mutual attraction because assignment to groups and peer tutoring increase contact between students and because interdependence among students causes students to like one another" (Slavin, 1978). In addition, group learning can aid students in becoming less dependent on teacher instruction and become more responsible for their own learning (Bingman & Koutnik, 1970).

Several techniques for cooperative learning have been developed in recent years. For example, several student-team learning techniques have been created by DeVries et al (1978) (Teams-Games-Tournaments, Student Team Achievement Divisions) and Aronson et al (1975) (Jigsaw) which combine the use of team competition and academic games in the classroom as a cooperative learning strategy. The success of these student-team learning techniques with regard to academic achievement, increased self-esteem, improved interpersonal relationships, and mainstreaming has been summarized by Slavin (1980). In addition, numerous modifications of these three basic techniques have been developed in recent years to meet special purposes or needs in the classroom.

Group Investigation (GI) is another cooperative learning technique that was developed by Sharan & Sharan (1976) and Sharan & Hertz-Lazarowitz (1980). According to this method, a class is divided into groups of 5-6 students for the study of a particular topic. Groups plan their strategy of study so that each student is involved in the formulation and completion of the project. Each student in the group selects a subtopic for which she or he is responsible. They contribute their research topic to the group and the group prepares and presents the material to the entire class. A group engaging in a GI project will proceed through six phases: topic selection, cooperative planning, implementation, analysis and synthesis, presentation of the final project, and evaluation. A description of these phases can be found in Sharan and Hertz-Lazarowitz (1980).

Slavin (1983) distinguished six types of cooperative structures on the interactive basis of two possible task structures and three possible incentive structures. He reviewed 46 experimental studies

contrasting these cooperative structures with either individual or competitive goals. He found that cooperative learning methods that used task specialization and group rewards, of which GI would be an example, increased student achievement more than control methods. Methods that used task specialization and individual rewards, however, did not have this effect. He suggested that because the number of task specialization studies are few, more research is needed before conclusions can be drawn.

In one study (Sharan et al, 1980) GI structure was reported to be more effective than a competitive structure in promoting learning on a high level of cognitive functioning. In a more recent study, Sharan (1984) compared GI instruction, Student Team Achievement Divisions (STAD), and whole-class (individually competitive) teaching strategies with regard to academic achievement, cooperative behavior, and social attitudes in the classroom. Results of his study indicated that the GI and STAD (cooperative) methods were similar in terms of their effect on academic achievement: both these methods were more effective than individually competitive whole-class instruction; and, the GI method was more effective than both STAD and whole-class instruction in terms of producing more positive social interactive behaviors and attitudes among students. Okebukola (1985) and Okebukola and Ogunniyi (in press) have examined 8th grade Nigerian science classes contrasting Johnson's GI technique, Aronson's Jigsaw and Slavin's TGT and STAD techniques with an individually competitive structure and determined that the most academically favorable structures were the cooperative ones, especially TGT and STAD. Okebukola's studies did not include Sharan's GI goal structure model. The objective of the present study was to provide further comparison concerning the effectiveness of a cooperative (i.e., Sharan's GI model) versus an individually competitive classroom structure with regard to achievement gains in two high school Biology classes. This was determined by teaching an identical unit of study to two different classes of approximately equal academic abilities, and comparing the achievement of students in the individually competitive structured class with student achievement in the class utilizing a cooperative group investigation model. Differences between the two classes and relative gains in achievement within each class were evaluated. It was hypothesized that while no significant (alpha > .05) difference between the two groups was expected on their pre-tests, both groups were expected to obtain significantly (alpha < .05) higher post-test scores. Furthermore, based on the results of previous studies, the class using the cooperative GI approach was expected to make significantly (alpha < .05) higher gains on their post-test scores as contrasted with the competitive classroom.

METHOD

SAMPLE. This project was conducted during Spring, 1985 in a midwestern, predominantly white, middle class rural high school. The subjects were from two sophomore level Biology classes of approximately equal academic abilities. Biology is an elective at the high school, and a majority of the students taking this course rank in the top one-third of their class. Class A (n=21) used the cooperative GI strategy; Class B (n=25) received the individually competitive

treatment. The unit of instruction examined in this study concerned ecology and environmental science. A significant portion (25%) of the students' 4th-term grades consisted of a research project concerning major biomes of the world. Both classes were exposed to the same study content, labs, in-class activities, homework, reading materials and the same instructor for seven weeks. They differed only in the classroom structure that was utilized.

PROCEDURES. Class A students learned by the GI cooperative technique. All in-class activities, labs, and projects were conducted in pre-assigned groups which consisted of 4-5 members who were equally diverse in terms of academic ability based on previous academic performance in the class, gender, and race. Grades were based on a criterion-referenced evaluation system. Each student within a group was required to contribute to the overall completion of the project. A major biome (tundra, coniferous forest, deciduous forest, grassland, desert, or tropics) was randomly assigned to each group. For each group, 5 major sub-topics concerning their particular biome was required to be addressed in the final report. Students decided amongst themselves who would be responsible for each topic. Final evaluation of the project was based on a) one written report per group with a contribution by each member, and b) a class presentation by each group with participation by each member. Each member of a group received the same final grade for the overall completion of the biome project. This project was designed after the group-investigation method as described by Sharan and Sharan (1976) and Sharan and Hertz-Lazarowitz (1980).

Class B students worked individually on all class activities throughout the 7-week unit. Grades were based on a norm-referenced evaluation scale. Each student in the class had the opportunity to choose the biome they wished to report on. Five major sub-topics concerning the biome were required to be addressed as with Class A.

Both Classes A and B were given three weeks to complete this assignment. Students in both classes were given two class periods during these three weeks to work on their projects. All other activities related to this assignment were conducted out-of-class. In addition to this major project, students performance on worksheets, labs, reading assignments and outdoor experiences were evaluated in both classes. Class A students conducted these activities in their pre-assigned groups; Class B students conducted them individually.

DEPENDENT MEASURE. The same teacher-made 40 item pre- and post-test was given to both classes at the beginning and end of the ecology unit. To insure reliability for this test a KR-21 coefficent was computed to be .71 on the post-test, which was considered to be an acceptable measure of internal consistency.

DESIGN AND ANALYSIS. A pre-test, post-test quasi-experimental design for two intact classroom groups (Cambell & Stanley, 1966) was used in this study and allowed two types of evaluation: 1) comparison of pre- and post-test scores within each class, and 2) comparison of changes between pre- and post-test scores between the two classes. Thus, a two-way within subjects ANOVA of mean achievement scores between groups (competitive vs. GI cooperative) across time (pre- and post-test scores) within subjects was utilized.

RESULTS

Pre- and post-test scores and changes between the two for Classes A and B are presented in Table 1. Results of the ANOVA for the stated hypotheses are illustrated in Table 2. Figure 1 illustrates a plot of mean pre- and post test scores for each treatment group. Results from the two-way ANOVA indicated a significant difference ($p<.0001$) in pre- and post-test scores. Post-test scores were significantly greater than pre-test scores for students in both treatment groups. The interaction F statistic (i.e., the treatment by time score) was used to determine differences between treatments with regard to academic achievement. No significant difference ($p>.05$) in pre-test or post-test scores between treatment groups was found. These data indicate that although both cooperative and competitive techniques were effective learning strategies, neither strategy was superior over the other in producing achievement gains. Possible reasons for this are discussed in the Conclusions section of this paper.

Table 1
Mean pre- and post-test scores in cooperative and competitive classrooms.

	Time	
Group	Pre-test	Post-test
Cooperative (n = 21)		
mean	18.33	25.19
sd	3.58	5.01
competitive (n = 25)		
mean	19.60	27.28
sd	6.04	5.64

Table 2
Two-way within subject ANOVA of Treatment (Cooperative vs. Competitive) by time (pre- vs. post-test).

Source	df	MSe	F	p<
Treatment	1	64.28	1.47	.229
Subject within treatment	44	43.33	--	--
Time (pre vs post)	1	1205.95	110.77	.001
Treatment by time	1	3.86	.35	--
Subject by time within treatment	44	10.89	--	--

CONCLUSIONS

Previous studies have reported greater academic achievement in cooperative versus competitive classroom reward structures (e.g., Holt, 1967; Johnson & Johnson, 1975; DeVries & Slavin, 1978; Slavin, 1978b; Sharan, 1984). Most of these previous studies, however, utilized a cooperative system with an incentive structure based on

group reward for individual learning with no task specialization, as described by Slavin (1983) (e.g., TGT, STAD). Slavin (1983) found this type of cooperative structure to be the most consistently effective in improving academic achievement. Only a few studies, however, have dealt with a cooperative system that has an incentive structure based on group reward for group performance with task specialization, as exemplified by the GI method. Two studies that did use GI reported greater academic achievement in GI versus competitively-structured classrooms (Sharan et al, 1980; Sharan, 1984). Results of the present study do not support these past observations: there was no significant difference in achievement between students learning in a cooperative (GI) environment and those learning in an individually competitive class. Both approaches equally and effectively produced significant learning.

This discrepancy between the results of the present study and those found in other reports may be due to the timing and the duration of this project which was accomplished during the final 10 weeks of the high school year. Students at that point in the year had already established friendship "circles." As a result, students may have been more resistant to a change in classroom structure than they would have been if cooperative learning had been established as a classroom norm at the beginning of the year. Sharan (1980) hypothesized that cooperative learning attempted at the beginning of the school year with newly composed classrooms may be more effective than when done after a class has already established a collective history.

A 35-day unit of study may also have not been sufficient time to effectively implement and evaluate a cooperative teaching strategy. According to Gibb's (1964) individual-group maturation model of group development, achievement of individual and group goals is not possible unless feelings of adequacy, self-esteem, and trust are felt by all members of the group. Personal observation suggests that this first stage of group development was not achieved by some of the group members in the cooperative classroom. As previously discussed, many students were resistant to change in classroom norms because of loyalties to already established friendship circles. One boy, for example often refused to participate in activities with his group and preferred to work alone. The GI method was an unfamiliar strategy to students. GI is a method that involves relatively complex cognitive learning tasks (Sharan, 1980), such as the selection and interpretation of data, problem-solving, and the collective synthesis of ideas. Sharan, et al (1979) suggest that the utilization of GI requires a greater investment in teacher training and educational change than do other cooperative techniques such as peer tutoring. Sharan's (1984) study comparing STAD, GI, and a competitive technique, for example, involved intensive teacher training and the sample size in terms of number of classses used (9-14 per teaching method) was greater, thus allowing for more accurate statistical analyses.

To summarize, the results showed no significant difference in academic achievement between students learning in a GI cooperative versus an individually competitive classroom environment. Both groups, however, obtained significantly higher post-test than pre-test scores, indicating that both pedagogical strategies have positive

effects on academic achievement. A factor not examined in this study, but which may be an important effect of a cooperative structure over a competitive one deals with the impact of cooperative learning on social values and racial attitudes. Cooperative learning methods have been found to have positive effects on self-esteem, race relations, and the acceptance of mainstreamed academically handicapped students (Slavin 1983). In addition, a cooperative environment may produce more positive attitudes towards learning and teachers than a competitive structure (Johnson et al, 1984). Future studies examining the effects of the GI cooperative learning model on academic achievement and attitudes towards learning are warranted.

REFERENCE NOTE

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